Background

According to the 2003 National Kidney Foundation (NKF) statistics, more than 450,000 Americans suffer from end stage renal disease (ESRD) and 341,000 of them receive hemodialysis. Even though this problem more frequently affects the adult population, 1.5% of the patients are below 19 years of age (1).

One of the main causes of hospital admissions in patients undergoing hemodialysis is vascular access failure (3). In native AV fistula 85% of the complications include thrombosis and inadequate flow. The most common underlying causes are venous outflow obstruction, inadequate inflow, and central venous stenosis. Infection, pseudoaneurysms, neoplasms and steal syndrome account for the other 15% of complications (2).

Due to the vital importance of this vascular access in hemodialysis patients, prompt recognition and treatment of a failed AV access are crucial and necessary. In our patient, we describe a case of complete occlusion of an upper extremity AV fistula in a young girl.

Case Report

We present the case of a young woman with a clinical history of ESRD who was diagnosed at 7 years of age with focal segmental glomerulosclerosis. At the age of 11 years, a left AV fistula was created for hemodialysis due to poor ultrafiltration through her peritoneal membranes. She was changed at age 15 years to hemodialysis via a brachiocephalic AV fistula to improve her left upper extremity. At age 16 year, the AV fistula remained with thrombosis and moderate stenosis of the venous outflow along with arterial inflow impairment requiring thrombolysis and balloon angioplasty. The AV fistula thrombosed at age 19 when the girl presented with absence of thrill at the AV fistula. Interventional duplex was considered for evaluation and treatment. Ultrasound and color Doppler imaging was performed showing thrombosis of the venous side of the AV fistula with no arterial inflow (Figure 1). The brachial artery was patent to the distal site.

A second episode of AV fistula thrombosis occurred at age 19 when the girl presented with absence of thrill at the AV fistula. Interventional duplex was considered for evaluation and treatment. Ultrasound and color Doppler imaging was performed showing thrombosis of the venous side of the AV fistula with no arterial inflow (Figure 1). The brachial artery was patent to the distal site.

The left external jugular vein was selected as the route of access for the thrombolysis and angioplasty, trying to avoid direct puncture into the outflow vein of the fistula.

Under general anesthesia, U/S of the left external jugular vein was done demonstrating a patent vein suitable for access and placement of a vascular sheath. With a Cinem/RV the guide wire was directed distal to the left subclavian vein and through the sheath, down the venous side and then traversing the arterial inflow to course retrograde up the arm.

Diagnostic venography confirmed the extensive thrombus filling the venous side along with an arterial inflow. A 4 mm stenosis of the outflow vein was seen. The Kumpe catheter was exchanged for a 0.035” angiographic guidewire which was passed into the clot and then followed by lytic thrombolysis using normal saline for a total of 445 ml of fluid during thrombolysis. Venography showed clearing of the great majority of clot (Figure 2).

The venous stenosis was dilated to 8 mm (Figure 3). Then, a Fogarty catheter was passed just into the arterial inflow, inflated, and pulled back across the inflow, twice, to address and dislodge the platelet (“gray”) thrombus that tends to form at this site. Finally, the arterial inflow was balloon dilated to 5 mm. At this point the fistula was now palpably pulsating and yielding a thrill. Venography at this point showed patent arterial inflow, but persistent narrowing at the venous stenosis (Figure 4), which was dilated to 12 mm without difficulty (Figure 5).

The shunt was removed from the left neck with easy hemostasis. The girl spent a brief time in the PACU before going for hemodialysis and being discharged home with a functioning AV fistula.

Discussion

Pediatric radiologists are often unfamiliar with the imaging and care of AV fistulas used for hemodialysis. Most of the complications that are seen and described clinically most often include problems with outflow, inflow and thrombosis. Our case illustrates how each of these is addressed and uses a novel approach with a single alternative access route to avoid dealing with complications arising from the use of the AV fistula.

METHODS OF HEMODIALYSIS ACCESS

Two different types of permanent vascular access for hemodialysis have been described: native AV fistula or prosthetic graft. The NKF Kidney Disease Quality Outcomes Initiative (KDOQI) in the 1997 clinical practice guidelines recommended the use of AV access on the first line of choice in patients requiring long-term hemodialysis due to the higher rates of failure and fewer number of complications (14). AV fistulas can be created at the wrist (radiophlebitis) or at the arm (brachiocephalic). AV grafts of synthetic material are of the prosthetic type and are recommended only in cases of impossibility of a direct Brachiocephalic (5). Radiopaque, braehiocephalic or brachiocephalic fistulae have been used in children greater than 50 kg and for brachiocephalic fistulae has been described in patients of less than 20 kg (2).

TREATMENT OF FISTULA MALFUNCTION

Surgical thrombectomy and percutaneous radiologic techniques can be used to reestablish adequate arterial flow. The two main steps used to reestablish venous flow are dilatation and filtration of the underlying venous or arterial stenoses (5). The Society of Interventional Radiology guidelines recommend treating stenosis greater than 50% when there are concomitant clinical abnormalities and flow new radiologic or arterial interventions. Dissections of asymptomatic stenoses treated by Dalkin techniques are beneficically in only 10% of cases (9).

Percutaneous radiologic techniques include:

- Thrombolysis using pharmacologic or purely mechanical techniques with success rates between 85-95%.
- Angioplasty with high pressure balloons selecting success rates ranging from 95-98% and one year primary patency rates from 81-97% (11).
- Cutting balloons are used in cases of resistant stenoses failing to expand high pressure balloon angioplasty (11).
- Self-expandable stent placement in cases of rupture of an outflow vein after balloon angioplasty and for treatment of stenoses recidiv (12).

A direct percutaneous technique with crossover catheters has been used most frequently to access dialysis fistulae without passing through skin, subcutaneous tissue, veins, arteries, or other structures that could compromise access, irregular underlying anatomy with sharp, angulated anastomosis that may be difficult to traverse, and long or tortuous course of the AV fistulae after the procedure (13).

In our patient, we were able to complete the entire procedure from the neck to the upper puncture and shorten the time of the procedure as well as expedite her hemodialysis.

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